



# **EXERCISING IN SPACE**



# OBJECTIVES



The students will be able to describe exercises used by astronauts to countermeasure the microgravity environment.

The students will be able to research exercise using a variety of tools including the internet.

The students will be able to present information to an audience using visual aides.

## **National Standards**

Science

Science as Inquiry

Structure and Function in Living Systems

Regulation and Behavior

Technology

Technology productivity tools

Technology communications tools

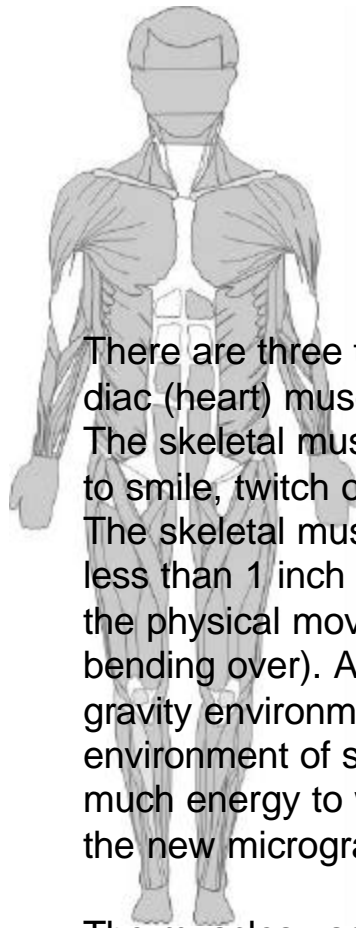
Technology research tools

Materials:

Various research tools (books, videos, internet, computers)

## **Background Information**

For many years doctors have been saying that proper fitness and diet are essential for a long and healthy life. Commercials on television, health food stores in local malls, and endless exercise and diet programs backup the doctors statements. Stair step, rowing, and weightlifting machines have proved to be big business in the fitness world. That is mainly due to the fact that humans have about 700 muscles in their bodies and these muscles make up about 50% of the body weight. Muscles act as cables that pull on bones to make motion of the human body possible. Because the human body relies on these muscles and bones for movement, taking good care of them is important.



There are three types of muscles in the body- skeletal muscle, cardiac (heart) muscle, and smooth muscle (example-iris of the eye). The skeletal muscles are responsible for movement. They allow us to smile, twitch our finger, wiggle our tongue, and blink our eyes. The skeletal muscles that produce these small movements are often less than 1 inch long. The larger muscles in the body are used for the physical movement of the body (walking, dancing, running, and bending over). All of these muscles are accustomed to working in a gravity environment on Earth. When exposed to the microgravity environment of space their jobs become easier. It does not take as much energy to work these muscles in space because they adapt to the new microgravity environment.

The muscles used to move through the Space Shuttle and the International Space Station are different than those used to walk down a hill on Earth. Muscles tend to become weak and they can no longer support the human body as they should when returned to Earth. Muscle atrophy (muscle deterioration) occurs when a person does not use his or her muscles for a period of time. For example, people who are confined to bed due to an illness or even astronauts in space experience natural muscle atrophy. In order to prevent such changes from occurring astronauts participate in planned exercise routines to insure that their muscles and bones are getting the resistance they are accustomed to on Earth.

## **Exercising in Space History**

Exercise programs in space have changed throughout the years. Time requirements and frequencies have increased. Longer missions require more exercise. On the first long-duration mission, Soviet flight Soyuz 9, the cosmonauts used elastic band type expanders for upper body exercise. They exercised twice a day for a total of one hour. On a 24 day flight the exercise expanded to 2.5 hours a day. The exercise routines included walking or running on a treadmill. By 1975 standard exercise programs began to be seen. Two exercise periods per day using a variety of equipment for a





total of 2.5 hours a day was standard. On early Mir (Russian Space Station) flights, cosmonauts were required to exercise 3 hours per day in 2 separate sessions.

## **International Space Station Exercise**

Astronauts aboard the International Space Station will use the treadmill, the Ergometer (cycle) and resistive exercise to help maintain muscle and bone strength. They will exercise approximately 90 minutes a day, six days a week. The seventh day will be the individual crew members choice. Individual preferences and requirements are taken into account when developing exercise programs.

## **Exercise Equipment**

NASA researchers have conducted several studies to determine which physical activities have the best effect on the body's ability to contribute to the maintenance or build-up of bone mineral density. These studies have shown that activities such as walking do not really countermeasure the effects of microgravity. Exercises that best enhance bone mineral density are high-load exercises or those that increase muscle strength.

The treadmill is a Teflon-coated aluminum sheet on a roller, which locks into holes in the floor. The treadmill is used with a restraint system to allow crew members to run or jog while in orbit. The restraint system consists of a waist belt, two shoulder straps, four extender hooks and a physiological monitor. Four force cords are used to hold the body in place during exercise. The treadmill has a speed control knob, which controls the braking system. The speed is determined on an individual basis according to the crew members maximal aerobic capacity. When the preset speed is reached, the brake engages and produces increased drag on the running track. The physiological monitor provides heart rate, run time and the distance accumulated.



## **Activity**

Working in groups of 4, the students will become expert astronaut personal trainers. Their job will be to develop an exercise routine for the astronauts that will countermeasure the effects caused by living and working in a microgravity environment. The teams will develop a product to be presented at the Expert Space Trainer Convention (the class) to be held on the last day of the project. A written presentation will be turned in for evaluation.

Job Description: Personal Trainer- Researches and develops physical exercise routines for long duration space travel.

Timeline:

Week One- Teacher presentation and team research

Week Two- Product preparation

Week Three- Expert convention presentations

Potential Areas for Evaluation:

1. That the teams are meeting the research requirements.
2. The recommendations that the teams give are viable solutions.
3. All requirements are met for the reports.
4. Technical writing ability meets teacher expectations.

# Astronaut Trainer Worksheet

Questions that should be researched (is not limited to)

1. List the effects of microgravity on the human body.
2. Why do astronauts exercise in space?
3. What types of exercise are conducted in space?
4. How long is a typical exercise routine in space?
5. What types of exercise equipment are used in space?
6. How do these exercises effect the body?
7. What physical difficulties do astronauts face on their return to Earth?





## Astronaut Trainer Worksheet #2

Research the types of exercise conducted on various space flights.  
List the resources used in this research.

Mercury:

Gemini:

Apollo:

Skylab:

Space Shuttle:

Mir Space Station:





# International Space Station:

## Student Handout #3

### Presentation Tips

1. Speak clearly and loudly enough for everyone in the room to hear.
2. Use visual aids in the presentation to make the thoughts and ideas visible to the listener.
3. Make sure that visual aides are big enough to be seen.

Small print is difficult to make out in the back of the room.

4. Know your subject.

Nothing is more boring than to listen to someone read off of a piece of paper. They could do that on their own.

5. Have fun then your audience will too.

### Report Guidelines (Choose two of the following)

1. Poster- describe and illustrate 6 exercise routines for space flight.
2. Report- illustrate space flight past, present, and future. (6 different examples) May be a powerpoint presentation.
3. Video- 6 minute scripted video introducing various exercises with explanations for how and why these exercises are to be conducted.

